



U.S. Department of Energy Energy Efficiency and Renewable Energy

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INDUSTRIAL TECHNOLOGIES PROGRAM

Intelligent Extruder for Polymer Compounding New Software Improves Process Control and Product Quality While Reducing Waste and Energy Use

GE Energy has introduced a powerful new system for closed-loop control of compounding extruders used to manufacture thermoplastics. Developed collaboratively by GE Energy, Coperion Werner & Pfleiderer, and the U.S. Department of Energy, the software system monitors and controls the blending of materials during the finishing stage in a compounding line. By carefully controlling material viscosity, the new system maintains tighter control of material properties, lowers production costs, and reduces energy use and waste generation.

Thermoplastics are used in myriad applications from kitchen countertops to automotive bumpers. Before being injection-molded, nearly every pound of resin passes through a finishing stage where the materials are blended in an extruder to achieve desired

chemical and mechanical properties. Product variability, which can result from variations in the incoming resin or from operator error, is a top customer concern. Variations in resin properties increase the initial setup time for injection molding and may necessitate readjustments during a run, resulting in more scrapped parts. The outcome is lost productivity, higher production costs, more waste, and customer dissatisfaction.

The Intelligent Extruder software alerts operators when out-of-spec material is being produced and brings production back into compliance automatically when process corrections are feasible. By improving the quality of material produced to customer specifications, the system increases first-pass product yield, thereby reducing rework requirements, while reducing energy use per pound of product.



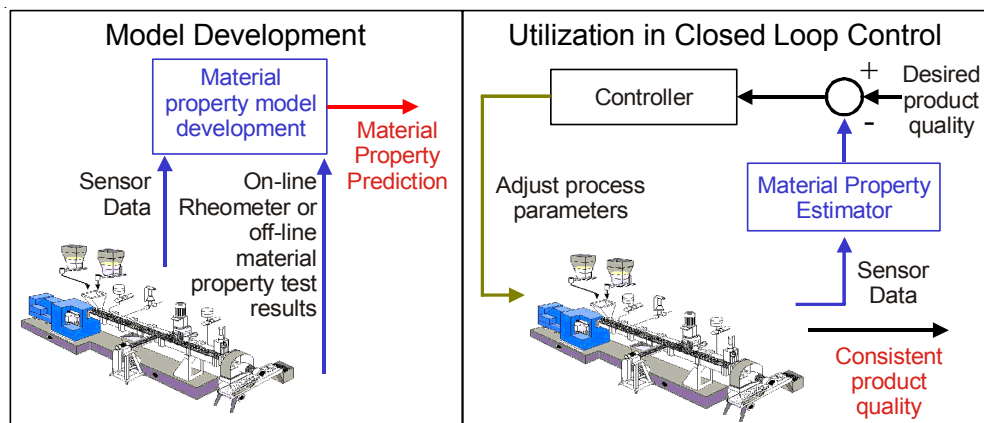
Benefits for Our Industries and Our Nation

The Intelligent Extruder software system:

- Improves the first-pass yield of compounding processes by 2 to 3% by reducing the quantity of out-of-spec material
- Reduces customer returns
- Reduces energy consumption per pound of product
- Reduces landfilling of scrapped material
- Reduces load on the quality lab for process checks

Applications in Our Nation's Industries

The Intelligent Extruder software system targets the extruded and molded plastics industry for primary use. The system could also benefit other markets such as petrochemicals, coatings (e.g., insulation, toners, fluoropolymers, fiber and film, reactive finishing, and injection molding).



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Project Summary

Objective:

The project objective was to develop and demonstrate a software-based monitoring, diagnostic, and control package that will reduce production variability, energy use, and off-grade product generation during the extruding stage of polymer compounding.

Technology:

The Intelligent Extruder software system improves the mixing, melting, and devolatilization of resins, fillers, pigments, and other additives by monitoring and controlling viscosity, a key quality parameter for polymer materials. The new system provides continuous on-line estimation of product viscosity and detects anomalous operation (and its root cause) through model-based analysis of the on-line estimates. An adaptive feedback control system compensates for process upsets, where feasible, by manipulating the composition of the feed. This closed-loop control process relies on a physics-based dynamic model whose generic structure can be applied to a wide range of product grades and operating conditions.

The software can be run on readily available process control instrumentation available off-the-shelf from multiple suppliers, using PCs, PLCs with PC-class process cards, or plant-level DCS systems.

Project Milestones:

This project was selected through the Sensors and Controls Program FY 1999 solicitation and was awarded in January 1999. Key tasks and milestones met were:

- On-line viscosity measurement experiments initiated May 2001
- Development of physics-based model for diagnostics and control mid 2001
- Completion of feedback control system late 2001
- On-line viscosity measurement experiments with closed-loop control initiated December 2001
- Confirmation of system performance 2002

Commercialization:

The commercialization of new process control technologies is not new to GE. To expedite the introduction of this technology to the marketplace, GE Energy and Coperion Werner & Pfleiderer are pooling their considerable resources in a technology and market development alliance.

For More Information

Please contact Paul Houpt at GE Global Research at haupt@research.ge.com for technical and marketing information on the Intelligent Extruder.

Project Partners

GE Global Research
Niskayuna, NY
(Prime)

GE Energy
Salem, VA

GE Plastics
Mt Vernon, IN
Selkirk, NY

Coperion Werner & Pfleiderer, USA
Ramsey, NJ

A Strong Energy Portfolio for a Strong America

Energy efficiency and clean, renewable energy will mean a stronger economy, a cleaner environment, and greater energy independence for America. Working with a wide array of state, community, industry, and university partners, the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy invests in a diverse portfolio of energy technologies.

For more information contact:

EERE Information Center
1-877-EERE-INF (1-877-337-3463)
www.eere.energy.gov



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The CPS number for this project is xxxx.

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